INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LGS-EE SERIES

This manual applies to units
bearing serial no. prefixes A - G.

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

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This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LGS-EE models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LGS-EE

TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
THEORY OF OPERATION	5
OPERATING INSTRUCTIONS	7
Basic Mode of Operation	7
Connection for Operation	7
Supply Load Connections	7
Operation After Protective Device Shutdown	8
MAINTENANCE	9
General	9
Trouble Analysis	9
Checking Transistors and Capacitors	9
Printed Circuit Board Maintenance Techniques	9
Trouble Chart	10
Performance Checks	12
Adjustment of Calibration Control R125	12
SERVICE	13
PARTS ORDERING	13

SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LGS-EE-5-OV-R	5 ± 5%	110.0	100.0	86.0	72.0
LGS-EE-6-OV-R	6 ± 5%	100.0	90.0	80.0	65.0
LGS-EE-12-OV-R	12 ± 5%	60.0	53.0	46.0	38.0
LGS-EE-15-OV-R	15 ± 5%	47.0	42.0	36.0	30.0
LGS-EE-20-OV-R	20 ± 5%	34.0	30.0	26.0	22.0
LGS-EE-24-OV-R	24 ± 5%	30.0	27.0	23.0	19.0
LGS-EE-28-OV-R	28 ± 5%	25.0	23.0	20.0	16.0

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range. Derate output current rating 10% for 187-242 VAC ("V" option) input.

REGULATED VOLTAGE OUTPUT

Regulation ..... 0.1% line or load with input variations from 105-132 or 132-105 volts AC and load variations from no load to full load.

Ripple and Noise ..... 10mV RMS, 35mV peak-to-peak for LGS-EE-5-OV-R,-6-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-EE-12-OV-R, -15-OV-R, -20-OV-R, -24-OV-R, and -28-OV-R with either positive or negative terminal grounded.

Temperature Coefficient ..... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volt output.

Programming Voltage ..... One-to-one voltage change.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

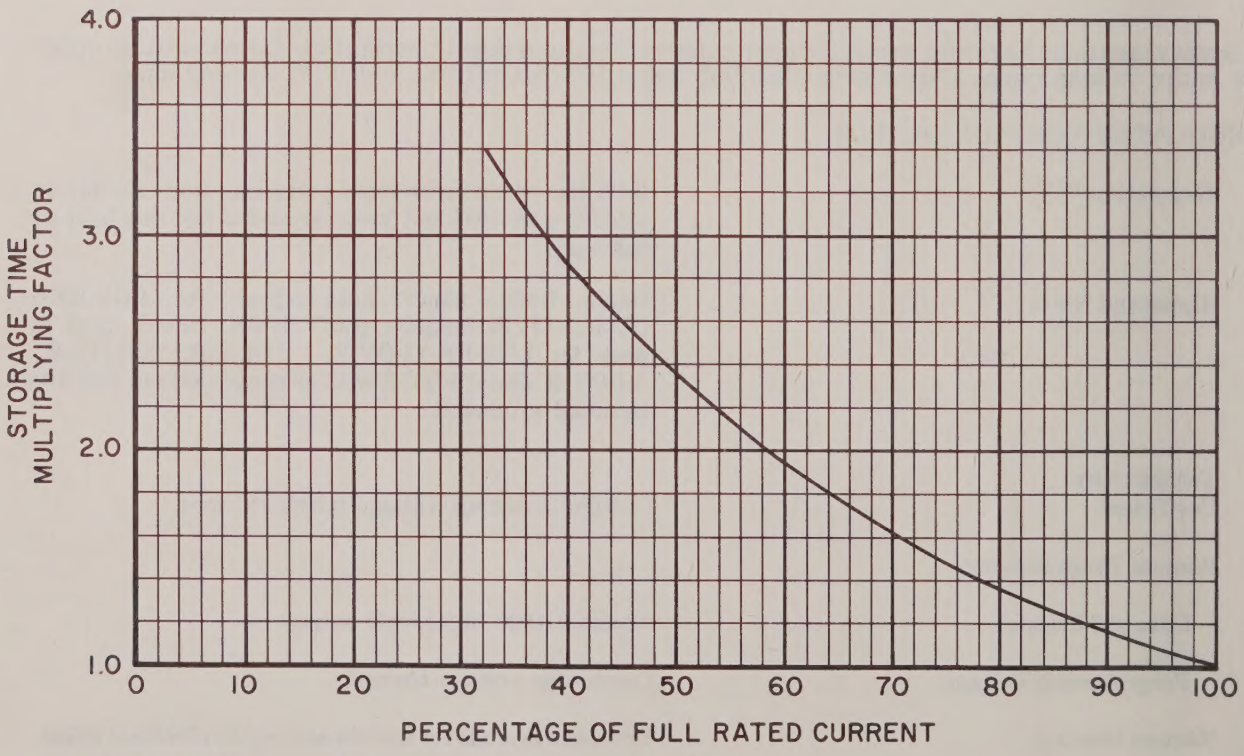
STORAGE TIME — Determine storage time regulation after input power failure as follows:

1. Find storage time at full rated current from chart below.
2. Determine percentage of full rated current for desired application.
3. Find multiplying factor on graph below.
4. Apply storage time formula:

$$S = (F)\,(M)$$

where S = storage time
F = storage time at full rated current (see chart)
M = multiplying factor (see graph)

MODEL	STORAGE TIME (ms) AT FULL RATED CURRENT
LGS-EE-5-OV-R	16.5
LGS-EE-6-OV-R	9.4
LGS-EE-12-OV-R	9.3
LGS-EE-15-OV-R	8.3
LGS-EE-20-OV-R	5.0
LGS-EE-24-OV-R	2.5
LGS-EE-28-OV-R	7.0



AC INPUT — 105-132, 205-265 or 187-242 ("V" option) VAC at 47-440 Hz.
Input power: 1100 Watts*. Input current: 14.0 amps**. For operation at frequencies above 440 Hz, consult factory.

*With output loaded to full current rating.
**With output loaded to full current rating and input voltage 105 VAC, 60 Hz.

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal ..... Thermostat resets automatically when over-temperature condition is eliminated.

Electrical

External ..... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

Internal ..... Fuse F2 provides protection against internal circuit failure.

OVERVOLTAGE PROTECTION — All LGS-EE models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS)
LGS-EE-5-OV-R	6.3 — 6.7
LGS-EE-6-OV-R	7.2 — 7.6
LGS-EE-12-OV-R	13.3 — 14.3
LGS-EE-15-OV-R	16.5 — 17.5
LGS-EE-20-OV-R	22.1 — 23.5
LGS-EE-24-OV-R	26.5 — 28.1
LGS-EE-28-OV-R	30.9 — 32.9

INPUT CONNECTIONS — Terminal block on rear of chassis.

OUTPUT CONNECTIONS — 1/4-28 studs on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to 85°C

FUNGUS — All LGS-EE power supplies are fungus inert.

VDC ADJ. Control — Voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

Size	7-1/2" x 4-15/16" x 16-1/2"
Weight	26 lbs. net; 31 lbs. shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — One surface with tapped mounting holes can be utilized for mounting this unit. LGS-EE power supplies must be mounted with Top facing up. Top must be in a horizontal plane. Refer to figure 10 for mounting details.

"V" OPTION — Standard LGS-EE power supplies can be obtained for 205-265 VAC input or 187-242 VAC input. See nameplate for AC input rating. Derate output current rating 10% for 187-242 VAC input. For operation at frequencies above 440 Hz, consult factory.

ACCESSORIES

Rack adapters	Rack adapter LRA-11 used for ruggedized mounting with or without chassis slides, is available.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an input circuit; an auxiliary rectifier and filter; a main output rectifier; and a main regulator circuit consisting of timing oscillator, flip-flop, comparator, nor gates, control and current limit amplifiers, and pulse width modulated inverter.

The circuit arrangement is shown in block diagram form in figure 8. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Input Circuit

Single phase AC input power is applied to silicon control rectifiers SCR5, SCR6 via EMI suppression network C20, C21, C18, C16, C27, C28, L3, L4, L5. Fuse F1 protects the power supply against excessive currents due to internal failure.

The input rectifier and voltage doubler capacitors C1, C2 provide power via center tap of T1, R2, R1, C104, and CR129 for the logic circuitry and provide power to the pulse width modulated inverter.

On initial turn-on, capacitors C1, C2 are charged via CR103, R15 and CR144, R16. Capacitor C107 is charged via R113. When the voltage on C107 exceeds the zener breakdown voltage of CR141, CR141 conducts, turning on control amplifier HC101 which, in turn, turns on the pulse width modulated inverter. The pulse width modulated inverter supplies gate voltage to SCR5 and SCR6 via CR5 and CR6. This action serves to prevent excessive in-rush current when unit is turned on.

Pulse Width Modulated Inverter

Positive and negative pulses are provided to the primary of T1 by the alternate conduction of Q1, Q3 and Q2, Q4. The duration of these pulses is determined by the conduction time of Q1, Q2, Q3, and Q4. This time is determined by the duration of the drive pulses applied to the bases of Q101 and Q102 by IC103.

When Q101 is turned on, voltage will be applied to the base of Q1 via C125, CR105, R204, CR108, CR110, and CR114 turning Q1 on. Current flow through T203A causes a voltage to be developed across T203B. This voltage turns on Q3. The voltage developed across T203C compensates for the loss of drive due to the voltage across T203A. As current through C125 decays, regenerative action holds Q1 on by providing base drive via CR10, CR9, R10, feedback winding of T1, CR115, and CR114. Diode CR118 prevents saturation of Q1 which would extend turn-off time. Resistor R101 provides sufficient current to keep Q103 and Q105 off.

When Q101 is turned off, C105 provides voltage to turn on Q103 which, in turn, turns on Q105. Bias circuit C101, Q107, CR128, C106 supplies negative bias to the base of Q1 via Q105, CR145, and R140. This action rapidly turns off Q1 and holds it off.

A similar sequence of events serves to turn Q2 and Q4 on and off as Q102 is turned on and off.

Output Circuit

Positive and negative pulses supplied by T1 secondary are rectified by full wave rectifiers CR1 through CR4; filtered by filter network C3, L1 and supplied to the output via E.M.I. suppression network C8, C9, C13, C14, L2, L9, L10, L11, L12.

Logic and Control Circuits

IC101 is a free running timing oscillator. The output, pin 3, of IC101 is high for 23 microseconds and low for 5 microseconds resulting in an overall period of 28 microseconds. The output of IC101 is fed into flip-flop IC102. IC102 is triggered by the leading edge of the IC101 output resulting in square waves having periods of 56 microseconds at the Q and $\overline{Q}$ (pins 1 and 2) outputs of IC102. Each square wave serves as one input to one of two nor gates located within IC103. The other input of each gate is provided by internal circuitry within IC103 connected as an amplitude comparator at pin 1 of IC103. Pin 1 of IC103 is controlled by the output of the hybrid control amplifier HC101.

HC101 control output is determined by changes in output voltage as sensed via L7, voltage control R19, and resistor R119. If the output voltage tends to decrease, current from pin 6 output of HC101 is delayed thereby delaying the charging of C119 and delaying the high input to pin 1 of IC103. This action delays the turning off of the drive output to Q101 or, as applicable Q102. When IC101 pin 3 goes low, the voltage at IC103 pin 1 is reset via CR126. The connection from IC101 pin 3 to IC103 pins 5 and 6 via CR127 serves to prevent Q101 and Q102 from being turned on while the timing oscillator is in the low state. This sequence is shown in the following truth table:

IC101	IC102		IC103			
TIMING OSCILLATOR	FLIP-FLOP OUTPUTS		INPUT	DRIVE OUTPUTS		REMARKS
Pin 3	Pin 1	Pin 2	Pin 1	Pin 10	Pin 11	
low	low	high	low	low	low	inverter dead period
high	low	high	low	high	low	drive Q101
high	low	high	high	low	low	inverter quiescent period
low	high	low	low	low	low	inverter dead period
high	high	low	low	low	high	drive Q102
high	high	low	high	low	low	inverter quiescent period
low	low	high	low	low	low	inverter dead period

Current Limit Operation

As the load current tends to increase, the inverter current increases, thereby increasing the voltage across resistor R5. This voltage is sensed by hybrid control amplifier HC101. The result is the progressive hastening of the current output from HC101 pin 6 and therefore, drive current to Q101 or, as applicable, Q102 is turned off sooner and sooner until the conduction time of the inverter becomes less than 3 microseconds.

As load impedance approaches short circuit the load current is held relatively constant.

Overvoltage Circuit Operation

When the output voltage reaches the trip-point of the hybrid overvoltage module, the module fires crow-barring the output of the supply. The current through the module is sensed by current sensor L8. The output of L8 triggers SCR101, crow-barring the logic circuitry and turning the inverter off.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40° C. For continuous operation, load current must not exceed the rating for each ambient temperature. When rated load current is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded AC lead to terminal 1.

The supply positive terminal is brought out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LGS-EE power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the main rectifier heat radiator exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by interrupting the AC input circuit for a period of 30 seconds. (Refer to TROUBLE SHOOTING CHART)

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 8, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.
2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.
3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.
4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.
5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:
   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.
   b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
1. Zero volts DC output, voltages across C1 and C2 read zero.	Open F1 CR7, CR8, SCR5, SCR6.	Check and replace as necessary.
2. Same as 1, voltages across C1 and C2 are correct, voltage across C104 is zero.	Thermostat S1 closed.	Refer to table 1 of SPECIFICATIONS AND FEATURES for current ratings at given ambient temperature. After allowing time for the power supply to cool, resume operation of the supply.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
	SCR101 fired due to OV condition	Interrupt AC input for 30 seconds. If supply operates normally, a transient has occurred in line or load, check wiring (switches, etc.). If supply fails to reach full output voltage, remove AC input, disconnect +V terminal of HC1, remove load, apply AC power and refer to procedure for: Output Too High "Symptom 4."
	R1 or R2 open, CR129 shorted.	Check and replace as necessary.
3. Same as 1, voltages across C1, C2, and C104 are correct.	Q1, Q2, Q3, Q4, F2, R5 open.	Check and replace as necessary.
4. Output voltage too high.	Open sense lead.	Check load and load connections, correct as necessary.
	Defective HC101. Open R119, R124, R130, CR122 — CR125	Check and replace as necessary.
5. Very low output voltage, voltage across C104 reads correct	R126, R127 open. HC101, SCR101 defective	Check and replace as necessary
6. High ripple	Defective HC101	Replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R125.

Whenever HC101, R5, or R125 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R125 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.
2. Break seal on wiper of R125 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with AC input of 132 VAC, 60 Hz.
4. Turn voltage adjust control until minimum rated output voltage is obtained.
5. Apply load so that output current is 110-115% of 40°C rating for the unit.
6.* Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and the unit emits an audible noise. Readjust R125 in CW direction until output ripple is restored to its original value and the noise ceases.
7.* After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.
8.* After sealing, check setting and repeat adjustment procedure if required.

* Perform alternate steps 6A through 8A for adjustment of R125 on models LGS-EE-5-OV-R and LGS-EE-6-OV-R.

6A. Using oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and oscilloscope pattern changes.

7A. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.

8A. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda models LGS-EE-5-OV-R — LGS-EE-28-OV-R are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common parts listing. In addition there is a separate listing of parts for the "V" option.

COMMON PARTS

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1, C2	Cap., elect., 2,900 mf -10 +100%, 200 vdc	CBS-29-136
C4	Cap., ceramic, 0.02 mf ±20%, 1,400 vdc	CDL-20-003
C5 thru C7	Cap., ceramic, 0.002 mf ±10%, 3,000 vdc	CDK-20-015
C8	Cap., ceramic, 0.01 mf ±20%, 500 vdc	CDM-10-002
C9	Cap., polycarbonate, 0.47 mf ±20%, 300 vdc	CGM-47-028
C10, C11	Same as C4	
C12	Cap., elect., 33 mf -10 +75%, 50 vdc	CBP-33-040
C13	Same as C8	
C14	Same as C9	
C15	Same as C5	
C16	Same as C4	
C17	Not assigned	
C18	Cap., paper, 0.15 mf ±10%, 400 vdc	CAM-15-017
C19	Same as C8	
C20, C21	Same as C5	
C22,+	Cap, mylar, 0.047 mf	CGL-47-018
C23+	± 10%, 200 vdc	
C24	Cap., elect., 3.3 mf ±20%, 35 vdc	CBN-33-019
C25	Cap., ceramic, 0.01 mf ±20%, 1,000 vdc	CDL-10-004
C26**	Same as C8	
C27, C28	Cap., ceramic, 0.01 mf -20 +80%, 3,000 vdc	CDL-10-014
C29, C30	Not assigned	
C31* thru C34*	Cap., ceramic, 470 pf ±20%, 1,000 vdc	CCJ-47-004
C101	Cap., elect., 40 mf -10 +100%, 60 vdc	CBP-40-047
C102	Cap., elect., 50 mf -10 +100%, 40 vdc	CBP-50-064
C103, C104	Same as C24	
C105	Cap., mylar, 0.22 mf ±10%, 80 vdc	CGM-22-004
C106	Cap., elect., 60 mf -10 +100%, 12 vdc	CBP-60-095
C107	Cap., elect., 3.5 mf -10 +100%, 400 vdc	CBN-35-035
C108	Not assigned	
C109†	Cap., mylar, 0.22 mf ±10%, 80 vdc	CGM-22-004
C110	Cap., mylar, 0.1 mf ±10%, 80 vdc	CGM-10-006

+ C22, C23 not used on units with serial no. prefixes A-E.

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C113 thru C116	Not assigned	
C117	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
C118	Cap., mica, 0.0018 mf ±2%, 500 vdc	CCK-18-003
C119, C120	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
C121	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
C122	Not assigned	
C123	Cap., mylar, 0.1 mf ±10%, 80 vdc	CGM-10-006
C124	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C125,* C126*	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C127	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
C128	Same as C118	
C201 thru C221	Not assigned	
C222, C223	Cap., elect., 10 mf ±20%, 10 vdc	CBP-10-027
CR5, CR6	Rectifier	FBL-00-103
CR7, CR8	Rectifier	FBL-00-052
CR9, CR10	Rectifier	FBL-00-039
CR11, CR12	Rectifier	FBL-00-105
CR101,†† CR102††	Same as CR5	
CR103	Rectifier	FBL-00-066
CR104	Not assigned	
CR105, CR106	Same as CR11	
CR107 thru CR111	Rectifier	FBL-00-082
CR112,† CR113,†	Same as CR5	
CR114 thru CR117		
CR118 thru CR121	Same as CR11	
CR122 thru CR125	Same as CR5	
CR126, CR127	Same as CR107	
CR128†	Rectifier, zener diode	FBM-Z103

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR129	Rectifier, zener diode	FBM-Z112
CR130	Not assigned	
CR131, CR132	Same as CR11	
CR133 thru CR140	Not assigned	
CR141	Rectifier, zener diode	FBM-Z126
CR142†	Rectifier	FBL-00-121
CR143	Not assigned	
CR144	Same as CR103	
CR145,† CR146†	Same as CR5	
CR147	Rectifier	FBL-00-064
CR149	Not assigned	
CR150* thru CR153*	Rectifier	FBL-00-030
CR201,†† CR202††	Same as CR5	
CR203 thru CR210	Not assigned	
CR211, CR212	Same as CR5	
CR213	Rectifier, zener diode	FBM-Z133
CR214 thru CR219	Not assigned	
CR220 thru CR223	Same as CR150	
F1**	Fuse, 25A, 3AB, NORM-BLO	FFJ-25-000
F2	Fuse, 8A, 3AB, NORM-BLO	FFJ-08-000
HC101	Hybrid regulator	FBH-00-002B
IC101	Integrated circuit	FBT-00-042
IC102	Integrated circuit	FBT-00-043
IC103	Integrated circuit	FBT-00-044
L2	Toroid	TCT-117-017
L3	Choke, AC	BBA-GSEE-3
L4	Choke, AC	BBA-GSEE-2
L5	Choke, AC	BBA-GSEE-6
L6	Not assigned	
L7	Choke, output sense	BBA-GS5-4
L8	Choke, 0 V	BBA-GSEE-5
L9 thru L12	Toroid	TCT-027-003
L101, L102	Not assigned	
L103	Choke, current sense	BBA-GSEE-1
Q1*++ thru Q4*++	Transistor, NPN	FBN-L200
Q101, Q102	Transistor, NPN	FBN-L177
Q103, Q104	Transistor, PNP	FBN-L176
Q105, Q106, Q107†	Transistor, PNP	FBN-L175
R1, R2	Res., ww, 2,000 ohms ±3%, 25 w	DFS-20-089
R4	Not assigned	
R5	Res., ww, 0.4 ohm ±3%, 30 w	DFM-40-089

++Q1 thru Q4 are FBN-L195 on units with serial no. prefixes B-F. R17, R18 are 100 ohms ±10% 1/2w comp. on units with serial no. prefixes A-F.

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R6	Not assigned	
R7, R8	Res., ww, 50 ohms ±3%, 20 w	DFP-50-043
R11 thru R14	Not assigned	
R15, R16	Res., ww, 6 ohms ±3%, 40 w	DFN-60-094
R17,++ R18	Res., ww, 300 ohms ±3%, 2W	DFR-30-040
R20, R21+	Res., ww, 300 ohms ±3%, 2w	DEB-1011
R101,* R102*	Res., comp., 330 ohms ±10%, ¼ w	DCB-3311
R103	Res., comp., 10,000 ohms ±10%, ¼ w	DCB-1031
R104, R105	Res., comp., 6,200 ohms ±5%, ¼ w	DCB-6225
R106	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011
R107	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701
R109	Not assigned	
R111	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R112	Res., comp., 4,700 ohms ±10%, ½ w	DEB-4721
R113	Res., comp., 27,000 ohms ±10%, ½ w	DEB-2731
R114	Res., comp., 150,000 ohms ±5%, 1 w	DGB-1545
R115	Not assigned	
R116	Res., comp., 180 ohms ±5%, 1 w	DGB-1815
R117	Res., film, 14,300 ohms ±1%, ½ w	DCT-14-091
R118	Res., film, 2,490 ohms ±1%, ½ w	DCS-25-037
R121,†† R122††	Res., comp., 1.0 ohm ±10%, ½ w	DEB-10G1
R123, R124	Not assigned	
R125	Res., var., cermet, 2,000 ohms ±10%, 1 w	DRS-20-018
R126	Res., comp., 2.7 ohms ±10%, ½ w	DEB-27G1
R127	Same as R17	
R128	Not assigned	
R129	Same as R116	
R130	Res., ww, 1,200 ohms ±3%, 3 w	DFS-12-016
R135†	Res., comp., 220 ohms ±10%, ½ w	DEB-2211
R136	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
R138, R139	Not assigned	
R140,† R141†	Res., comp., 3.3 ohms ±10%, ½ w	DEB-33G1
R201 thru R203	Not assigned	
R204	Res., comp., 220 ohms ±10%, ¼ w	DCB-2211
R205	Not assigned	
R206	Same as R204	
R207 thru R212	Not assigned	

+R20, R21 not used on units with serial no. prefixes A-E. R20, R21 are 100 ohms ±10% 1/2w comp. on units with serial no. prefix F.

COMMON PARTS (Cont.)

MODELS LGS-EE-5-OV-R — LGS-EE-28-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R213, R214	Res., comp., 100,000 ohms ±10%, 1 w	DGB-1041
R215 thru R220	Not assigned	
R221,†† R222††	Same as R121	
S1	Thermostat	FKA-110-026
SCR1 thru SCR4	Not assigned	
SCR5, SCR6+	Rectifier, silicon controlled	FBP-00-037
SCR101	Rectifier, silicon controlled	FBP-00-045
T201	Not assigned	
T202, T203	Transformer	ABA-GSEE-1
XF1	Fuse clips (2 req'd)	HRM-00-010
XF2	Fuseholder	HRM-00-009

* On units with serial no. prefix A: C125, C126 are 0.047 mf 80 vdc, CGL-47-013; Q1 thru Q4 are FBN-L178; R101, R102 are 470 ohms, DCB-4711; C31 thru C34, CR150 thru CR153 are not used.

† Only used on units with serial no. prefix A.

** On units with serial no. prefixes A—C, F1 is 20A, FFJ-20-000. C26 only used on units with serial no. prefixes A—C.

†† CR101, CR102, CR201, CR202, R121, R122, R221, R222 are not used on units with serial no prefixes A—D & G.

\+ SCR-5, SCR-6 are FBP-00-046 on units with serial no. prefixes A—E.

UNIQUE PARTS

MODEL LGS-EE-5-OV-R

C3	Cap., elect., 100,000 mf -10 +50%, 7.5 vdc	CBV-10-003
C111, C112	Not assigned	
C121	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-119
CR148	Not assigned	
HC1	Hybrid circuit	L-20-OV-5
L1	Filter choke	BBA-LGSEE-5
R3	Res., comp., 12 ohms ±10%, 1 w	DGB-1201
R9	Res., ww, 25 ohms ±3%, 5w	DFP-25-066
R10	Res., ww, 16 ohms ±5%, 40 w	DFP-16-055
R19	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-010
R108	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110††	Res., comp., 22,000 ohms ±10%, ¼ w	DCB-2231
R119	Not assigned	
R120	Res., film, 20 ohms ±5%, ½ w	DCP-20-026
R131 thru R134, R137	Not assigned	
T1	Transformer	ABA-LGSEE-5

UNIQUE PARTS (Cont.)

MODEL LGS-EE-6-OV-R

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C3	Cap., elect., 100,000 mf -10 +50%, 7.5 vdc	CBV-10-003
C111, C112	Not assigned	
C121	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-119
CR148	Not assigned	
HC1	Hybrid circuit	L-20-OV-6
L1	Filter choke	BBA-LGSEE-5
R3	Res., comp., 12 ohms ±10%, 1 w	DGB-1201
R9	Res., ww, 25 ohms ±3%, 5w	DFP-25-066
R10	Res., ww, 16 ohms ±5%, 40 w	DFP-16-055
R19	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-010
R108	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110††	Res., comp., 22,000 ohms ±10%, ¼ w	DCB-2231
R119	Not assigned	
R120	Res., film, 20 ohms ±5%, ½ w	DCP-20-026
R131 thru R134, R137	Not assigned	
T1	Transformer	ABA-LGSEE-6

MODEL LGS-EE-12-OV-R

C3	Cap., elect., 65,000 mf -10 +50%, 15 vdc	CBT-65-053
C111*	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C112*	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C121†	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-118
CR148*	Rectifier	FBL-00-082
HC1	Hybrid circuit	L-20-OV-12
L1	Filter choke	BBA-LGSEE-12
Q107*	Transistor, PNP	FBN-L118
Q108*	Transistor, NPN	FBN-L110
R3	Res., comp., 33 ohms ±10%, 1 w	DGB-3301
R9	Res., ww, 100 ohms ±3%, 5 w	DFR-10-025
R10	Res., ww, 25 ohms ±5%, 40 w	DFP-25-056
R19	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-010
R108†	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831
R119	Res., film, 7,500 ohms ±1%, ¼ w	DCS-75-072
R120	Res., film, 20 ohms ±5%, ½ w	DCP-20-026
R131*	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731

†† R110 was 68,000 ohms ±10%, ¼w, DCB-6831 on units with serial no. prefixes A-F.

UNIQUE PARTS (Cont.)

MODEL LGS-EE-12-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R132*	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R133*	Same as R131	
R134*	Res., comp., 68 ohms ±10%, ½ w	DEB-6801
R135*	Same as R132	
R137*	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
T1	Transformer	ABA-LGSEE-12

* Not used on units with serial no. prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-15-OV-R

C3	Cap., elect., 55,000 mf -10 +50%, 17.5 vdc	CBT-55-054
C111*	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C112*	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C121†	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-118
CR148*	Rectifier	FBL-00-082
HC1	Hybrid circuit	L-20-OV-15
L1	Filter choke	BBA-LGSEE-15
Q107*	Transistor, PNP	FBN-L118
Q108*	Transistor, NPN	FBN-L110
R3	Res., comp., 33 ohms ±10%, 1 w	DGB-3301
R9	Res., ww, 110 ohms ±3%, 5 w	DFR-11-115
R10	Res., ww, 25 ohms ±5%, 40 w	DFP-25-056
R19	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-010
R108†	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831
R119	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047
R120	Res., film, 20 ohms ±5%, ½ w	DCP-20-026
R131*	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731
R132*	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R133*	Same as R131	
R134*	Res., comp., 68 ohms ±10%, ½ w	DEB-6801
R135*	Same as R132	
R137*	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
T1	Transformer	ABA-LGSEE-15

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

UNIQUE PARTS (Cont.)

MODEL LGS-EE-20-OV-R

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C3	Cap., elect., 45,000 mf -10 +50%, 25 vdc	CBT-45-055
C111*	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C112*	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C121†	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-118
CR148*	Rectifier	FBL-00-082
HC1	Hybrid circuit	L-20-OV-20
L1	Filter choke	BBA-LGSEE-20
L13	I bar	TCI-460-003
	U core	TCU-460-002
Q107*	Transistor, PNP	FBN-L118
Q108*	Transistor, NPN	FBN-L110
R3	Res., comp., 47 ohms ±10%, 1 w	DGB-4701
R9	Res., ww, 150 ohms ±5%, 10w	DFR-15-116
R10	Res., ww, 25 ohms ±5%, 40 w	DFP-25-056
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
R108†	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110	Res., comp., 100,000 ohms ±10%, ¼ w	DCB-1041
R119	Res., film, 13,300 ohms ±1%, ¼ w	DCT-13-067
R120	Res., film, 27 ohms ±5%, ¼ w	DCP-27-023
R131*	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731
R132*	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R133*	Same as R131	
R134*	Res., comp., 68 ohms ±10%, ½ w	DEB-6801
R135*	Same as R132	
R137*	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
T1	Transformer	ABA-LGSEE-20

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-24-OV-R

C3	Cap., elect., 32,000 mf -10 +50%, 30 vdc	CBT-32-056
C111*	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C112*	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C121†	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-118
CR148*	Rectifier	FBL-00-082

UNIQUE PARTS (Cont.)

MODEL LGS-EE-24-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
HC1	Hybrid circuit	L-20-OV-24
L1	Filter choke	BBA-LGSEE-24
L13	I bar	TCI-460-003
	U core	TCU-460-002
Q107*	Transistor, PNP	FBN-L118
Q108*	Transistor, NPN	FBN-L110
R3	Res., comp., 47 ohms ±10%, 1 w	DGB-4701
R9	Res., ww, 150 ohms ±5%, 10w	DFR-15-116
R10	Res., ww, 25 ohms ±5%, 40 w	DFP-25-056
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
R108†	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110	Res., comp., 100,000 ohms ±10%, ¼ w	DCB-1041
R119	Res., film, 18,200 ohms ±1%, ¼ w	DCT-18-068
R120	Res., film, 27 ohms ±5%, ¼ w	DCP-27-023
R131*	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731
R132*	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R133*	Same as R131	
R134*	Res., comp., 68 ohms ±10%, ½ w	DEB-6801
R135*	Same as R132	
R137*	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
T1	Transformer	ABA-LGSEE-24

* Not used on units with serial no. prefixes A—D.

† Only used on units with serial no. prefixes A—D.

MODEL LGS-EE-28-OV-R

C3	Cap., elect., 32,000 mf -10 +50%, 30 vdc	CBT-32-056
C111*	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C112*	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C121†	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
CR1 thru CR4	Rectifier	FBL-00-118

UNIQUE PARTS (Cont.)

MODEL LGS-EE-28-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR148*	Rectifier	FBL-00-082
HC1	Hybrid circuit	L-20-OV-28
L1	Filter choke	BBA-LGS-EE-28
L13	I bar	TCI-460-003
	U core	TCU-460-002
Q107*	Transistor, PNP	FBN-L118
Q108*	Transistor, NPN	FBN-L110
R3	Res., comp., 47 ohms ±10%, 1 w	DGB-4701
R9	Res., ww, 220 ohms ±3%, 10w	DFR-22-118
R10	Res., ww, 25 ohms ±5%, 40 w	DFP-25-056
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
R108†	Res., comp., 1,500 ohms ±10%, ½ w	DEB-1521
R110	Res., comp., 100,000 ohms ±10%, ¼ w	DCB-1041
R119	Res., film, 20,000 ohms ±1%, ¼ w	DCT-20-053
R120	Res., film, 27 ohms ±5%, ¼ w	DCP-27-023
R131*	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731
R132*	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R133*	Same as R131	
R134*	Res., comp., 68 ohms ±10%, ½ w	DEB-6801
R135*	Same as R132	
R137*	Res., comp., 100,000 ohms ±10%, ½ w	DEB-1041
T1	Transformer	ABA-LGSEE-28

* Not used on units with serial no prefixes A—D.

† Only used on units with serial no. prefixes A—D.

PARTS FOR "V" OPTION

On all LGS-EE models with suffix "V", C29 is added and R110 changes value on models LGS-EE-5-OV-R and LGS-EE-6-OV-R. Part no. changes and additions are listed here.

ALL MODELS

F1	Fuse, 10A, 3AB, NORM-BLO	FFJ-10-000
C29+	Cap., ceramic, 0.01 mf ±20%, 1000 vdc	CDL-10-004
R110+	Res., comp., 22,000 ohms ±10%, 1/4w	DCB-2231

+ On units with serial no. prefixes A-F C29 not used. R110 was 68,000 ohms on 5v and 6v units.

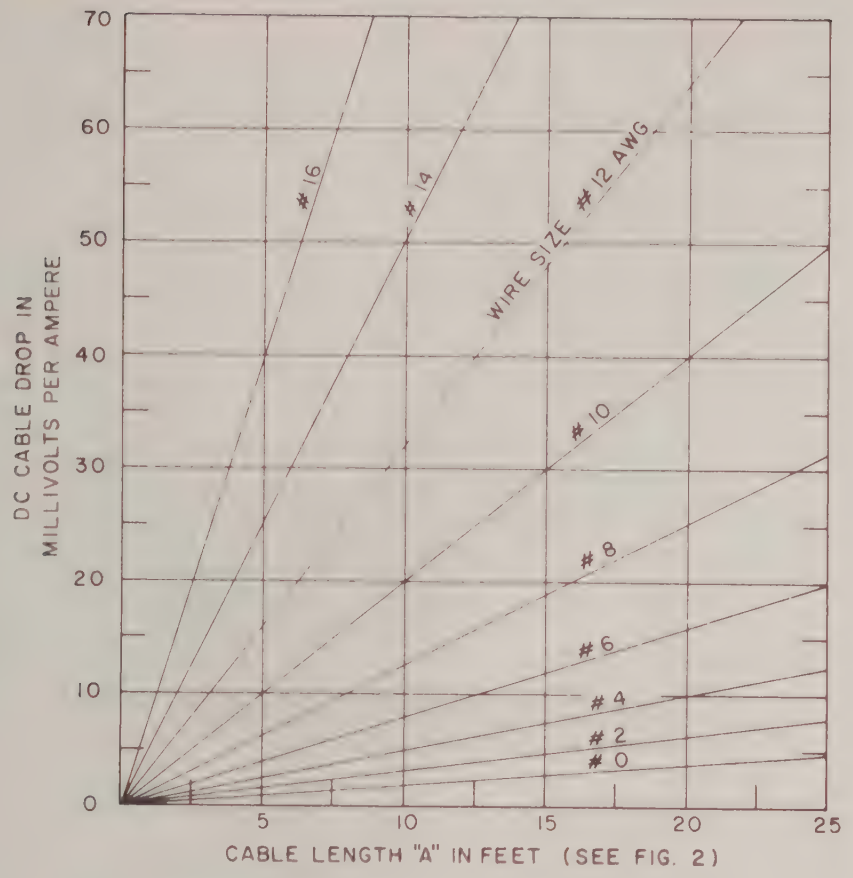


Figure 1. Cable Connection Chart

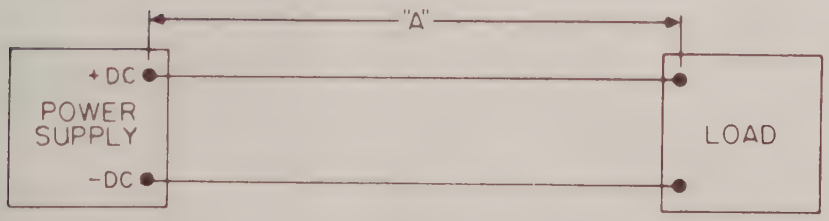
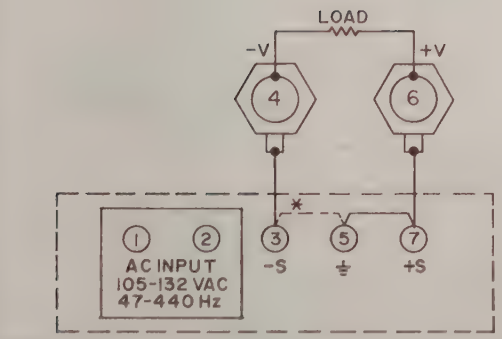
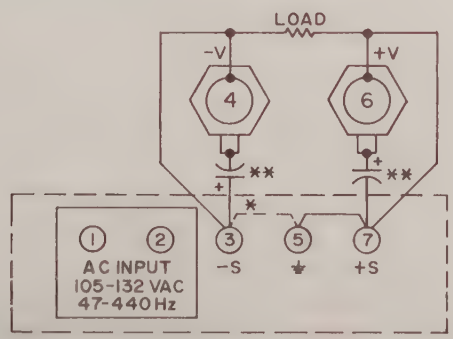


Figure 2. Cable Length "A" in Feet



NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 7 AND RECONNECT TO TERMINALS 5 AND 3.

Figure 3. Local Sensing Connections



NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 7 AND RECONNECT TO TERMINALS 5 AND 3.
** A 2.5 MF, ELECT., CAP MAY BE REQUIRED.

Figure 4. Remote Sensing Connections

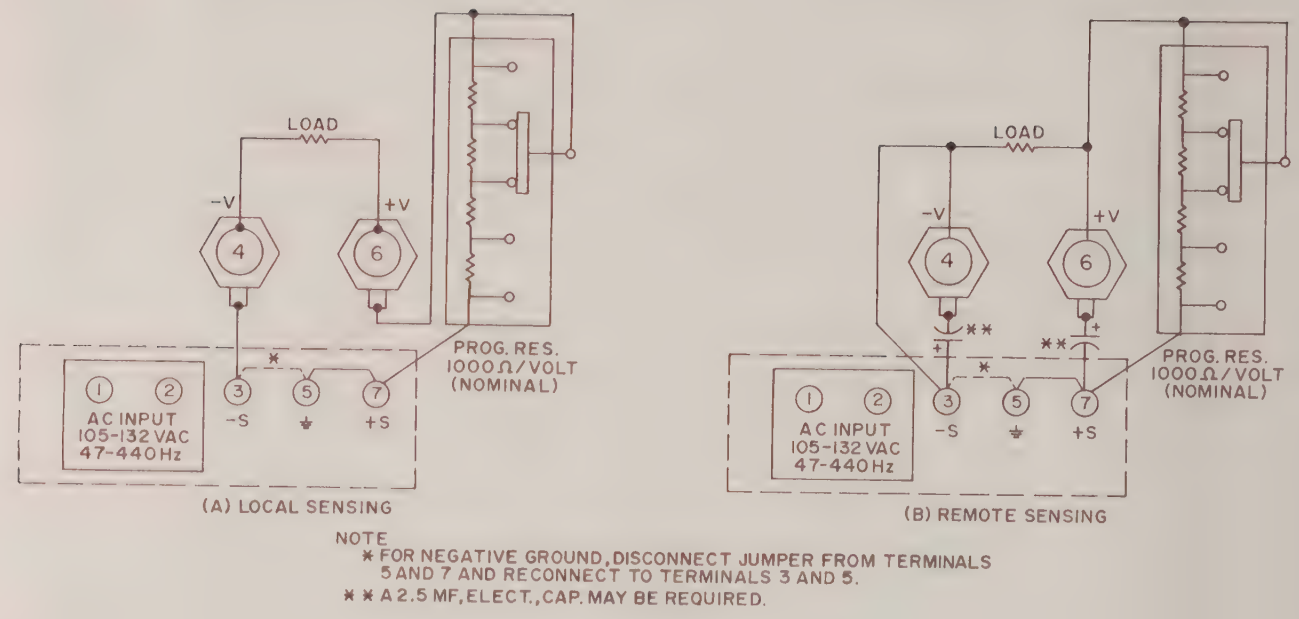


Figure 5. Programmed Voltage, with External Resistor.

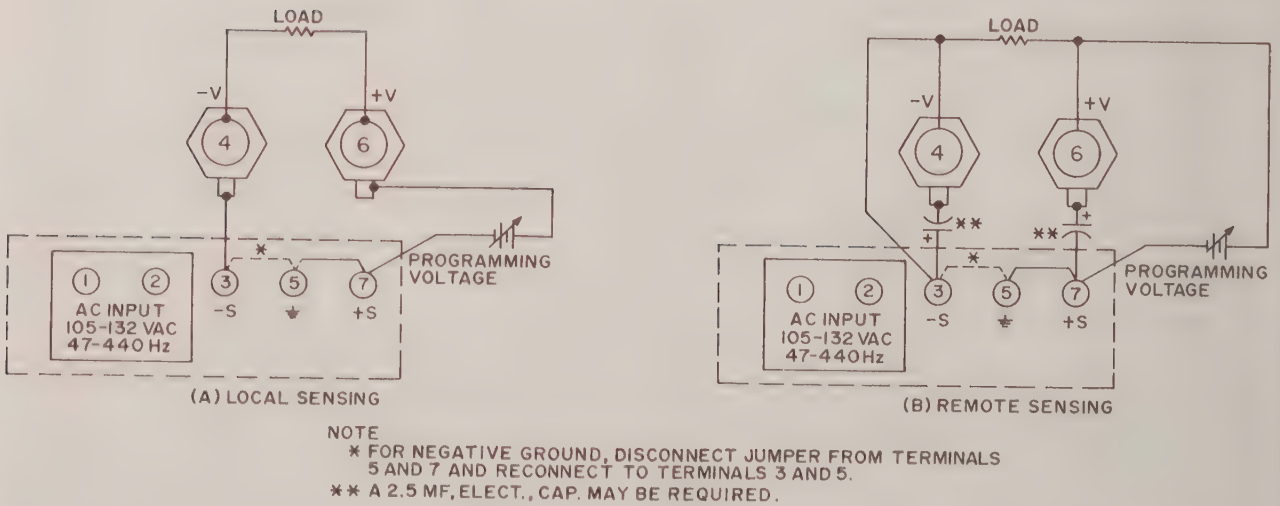
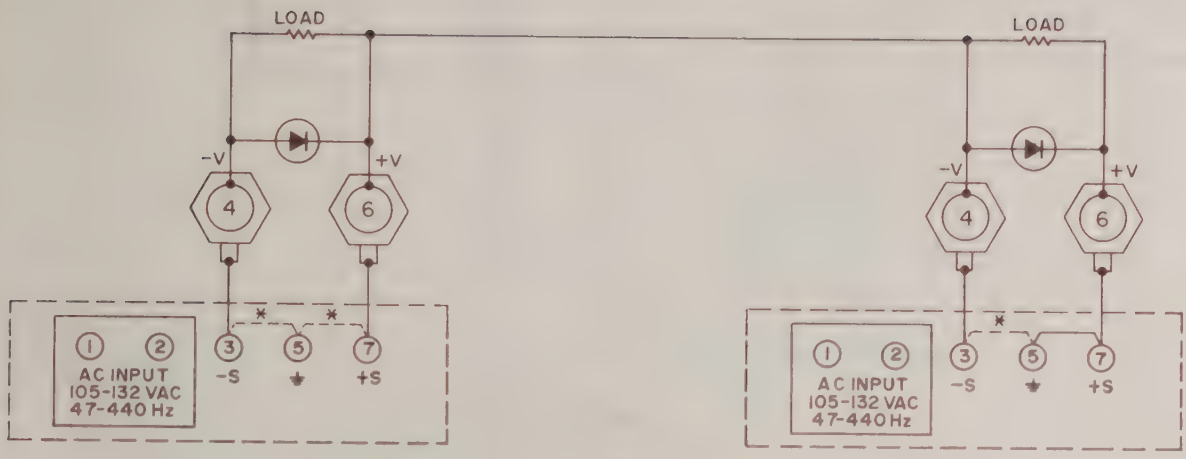
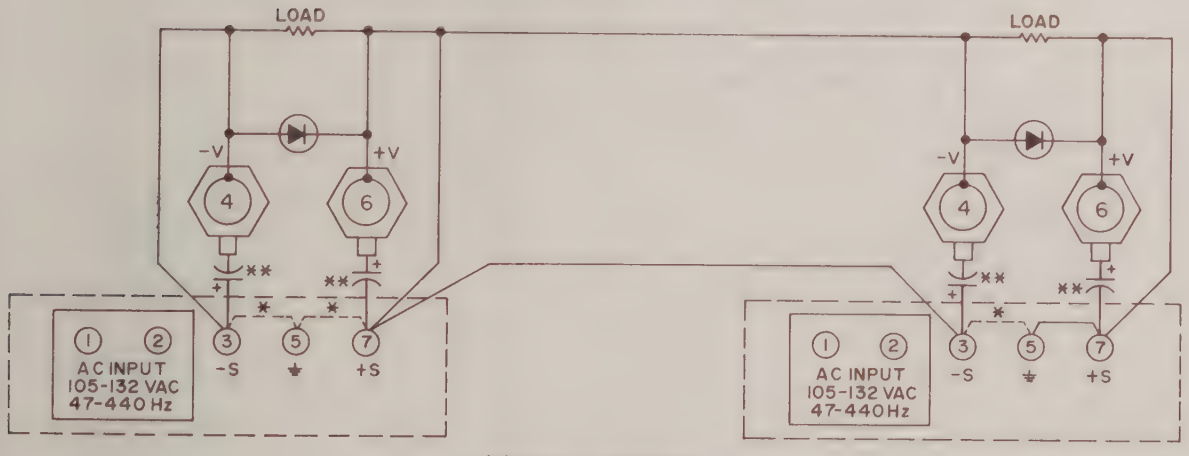


Figure 6. Programmed Voltage, with External Programming Voltage Source



(A) LOCAL SENSING



(B) REMOTE SENSING

NOTE:

* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 7 ON RIGHT UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection

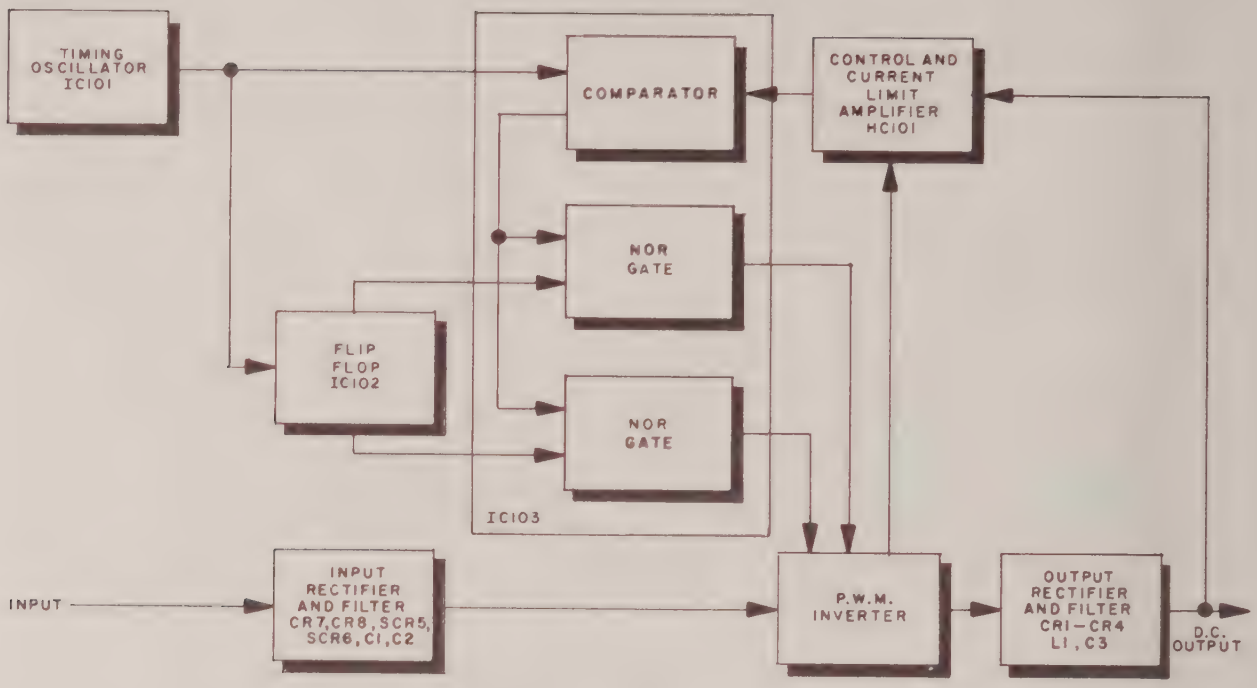
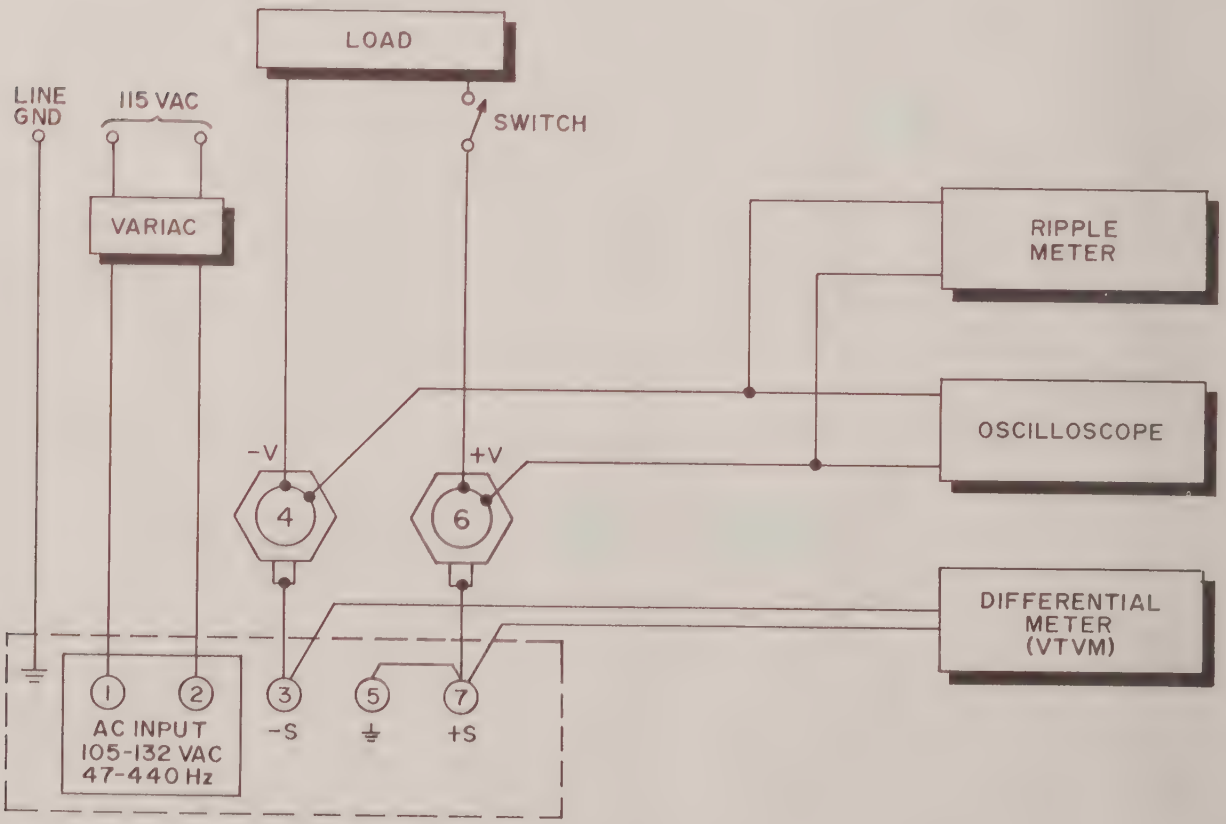


Figure 8. Typical Block Diagram



NOTES

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTION ONLY

Figure 9. Test Connections for Performance Checks

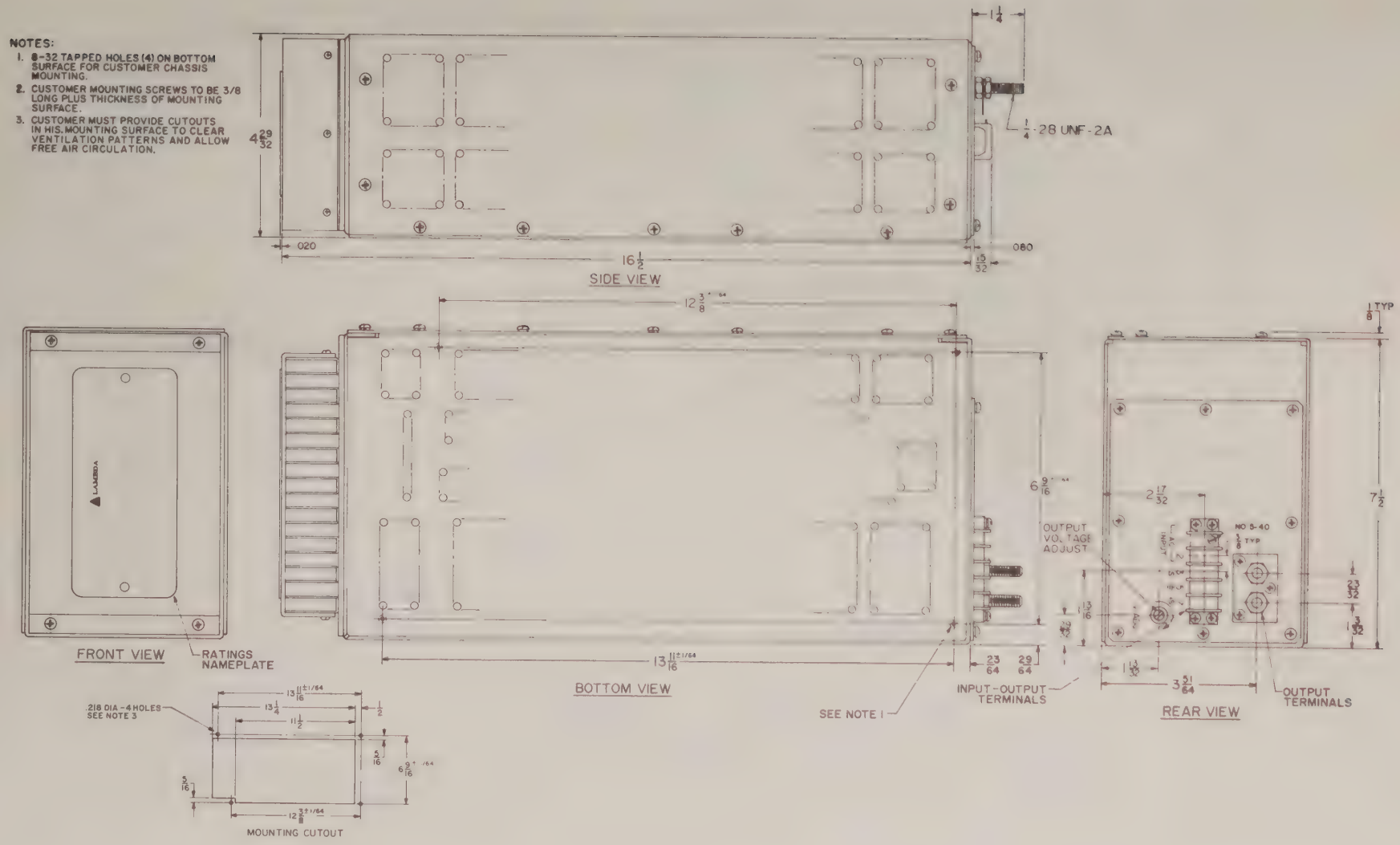
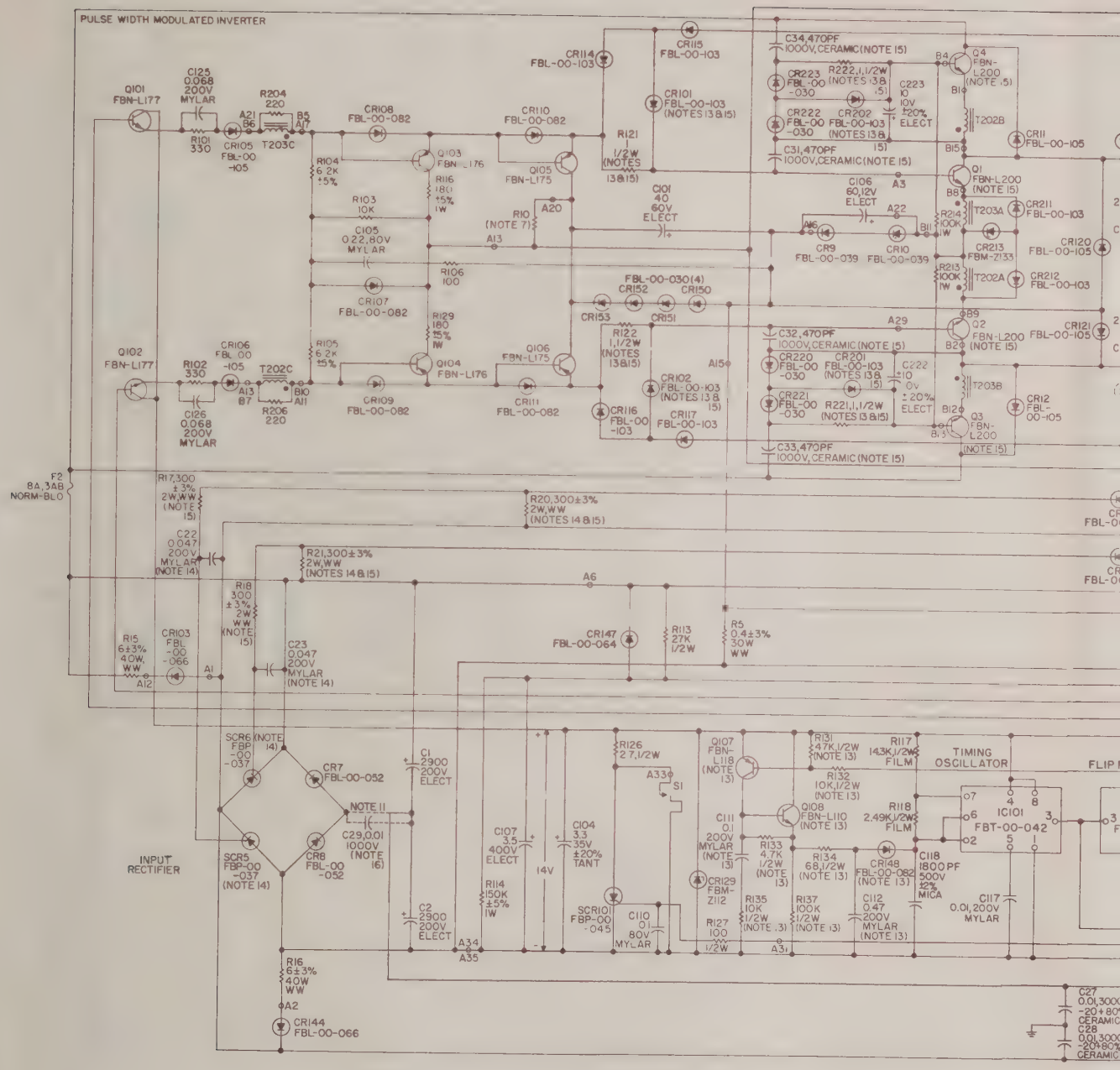

NOTES:
1. 8-32 TAPPED HOLES (4) ON BOTTOM SURFACE FOR CUSTOMER CHASSIS MOUNTING.
2. CUSTOMER MOUNTING SCREWS TO BE 3/8 LONG PLUS THICKNESS OF MOUNTING SURFACE.
3. CUSTOMER MUST PROVIDE CUTOUTS IN HIS MOUNTING SURFACE TO CLEAR VENTILATION PATTERNS AND ALLOW FREE AIR CIRCULATION.
SIDE VIEW
FRONT VIEW
RATINGS NAMEPLATE
BOTTOM VIEW
SEE NOTE 1
INPUT-OUTPUT TERMINALS
OUTPUT VOLTAGE ADJUST
REAR VIEW
OUTPUT TERMINALS
MOUNTING CUTOUT
.218 DIA - 4 HOLES SEE NOTE 3

Figure 10. Outline Drawing

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-5-0V-R THRU LGS-EE-15-0V-R
BEARING SERIAL NO. PREFIXES B-G

Models	Schematic Voltage Measurements		Schematic Components						
			C3	CR1-CR4	HC1	R3	R9	R10	R119
	A (Vp)	B (VDC)	-10±50% ELECT	FBL-00-*	L-20-0V-*	±10%, 1w COMP	±3% WW	±5%, 40w WW	±1%, 1/4w FILM
LGS-EE-5-0V-R	11	5.0	100,000 mf 7.5 vdc	119	5	12	25 5W	16	Jumper
LGS-EE-6-0V-R	13	6.0	100,000 mf 7.5 vdc	119	6	12	25 5W	16	Jumper
LGS-EE-12-0V-R	22	12.0	65,000 mf 15 vdc	118	12	33	100 5W	25	7.5K
LGS-EE-15-0V-R	31	15.0	55,000 mf 17.5 vdc	118	15	33	110 5W	25	10K

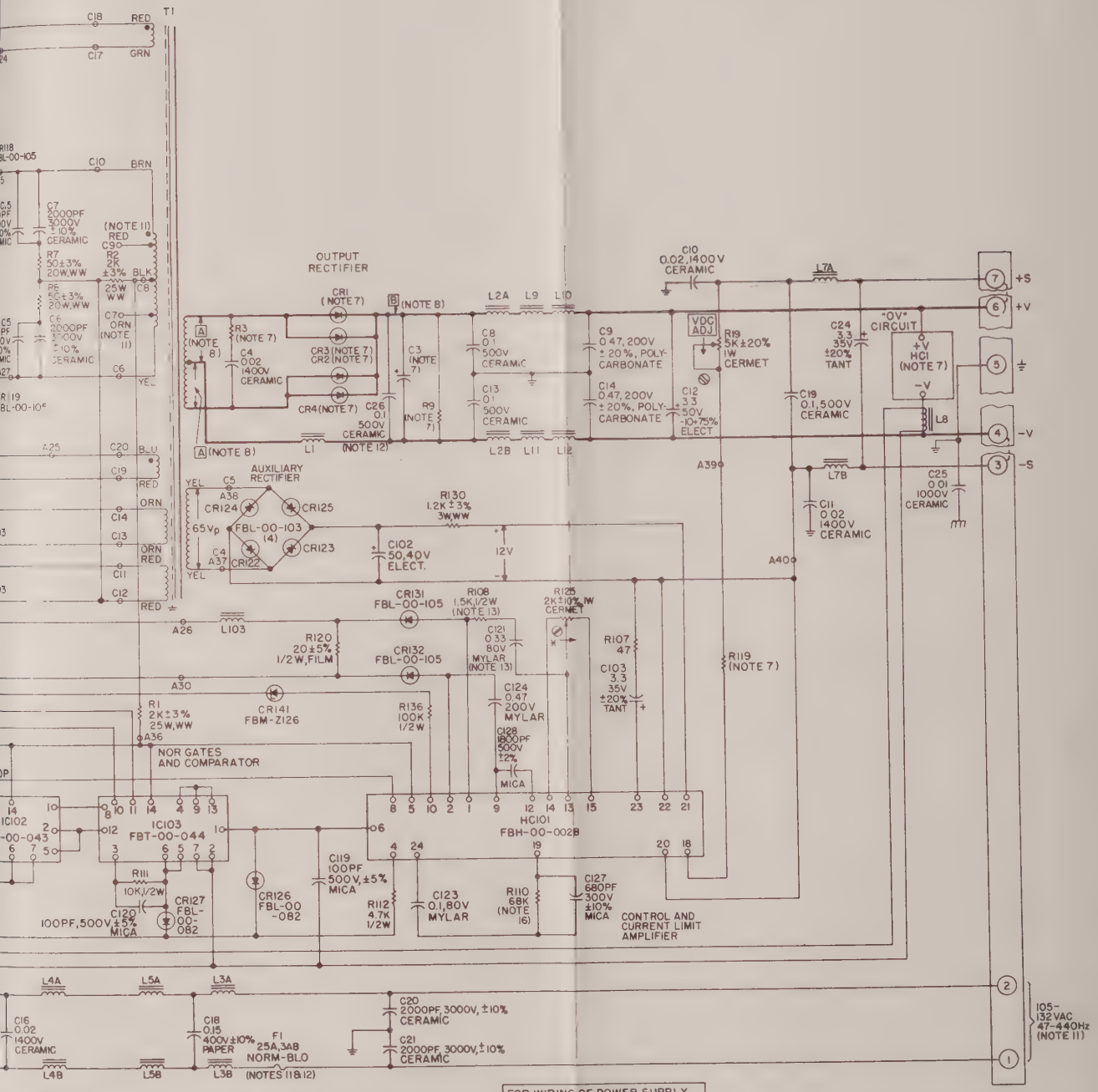
* Lambda part no.



NOTES

1. RESISTORS ARE 1/4W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%, FILM ±1%, WIREWOUND ±5%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10 +100%, CERAMIC ±20%, MYLAR ±10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ✱ SEE INSTRUCTION MANUAL
   - ⊸ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 57-63 Hz. NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. AC MEASUREMENTS ARE PEAK VALUES MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S (TERM. 3) UNLESS OTHERWISE NOTED.
10. THE FOLLOWING W
BETWEEN INDICAT
OTHERWISE NOTED

IC101, PIN 3	
IC102, PIN 1	
IC102, PIN 2	
IC103, PIN 1	
IC103, PIN 10	
IC103, PIN 11	
SECONDARIES OF T1 (MEASURED BETWEEN POINTS INDICATED ON DIAGRAM WITH OUTPUT LOADED TO 10% OF RATED CURRENT MINIMU	



11. ON UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN TO CR7, CR8 REPLACES CONNECTION TO C1, C2; F1 IS 10A; T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TERMINALS C7 AND C9) OR FOR 205-265V INPUT (USING TERMINALS C6 AND C10).
12. ON UNITS WITH SERIAL NO. PREFIXES B&C, F1 IS 20A. C26 ONLY USED ON UNITS WITH SERIAL NO. PREFIXES B&C.
13. ON UNITS WITH SERIAL NO. PREFIX B-D: CR101, CR102, CR201, CR202 ARE NOT USED; R121, R122, R221, R222 ARE JUMPERS. C111, C112, CR148, Q107, Q108, R131, R132, R133, R134, R135, R137 ARE ONLY USED ON MODELS LGS-EE-12-0V-R AND LGS-EE-15-0V-R WITH SERIAL NO. PREFIXES FROM E ON. C121 AND R108 ARE NOT USED ON THESE UNITS.
14. ON UNITS WITH SERIAL NO. PREFIXES A-E: SCR5 AND SCR6 ARE FBP-00-046; R20, R21, C22 AND C23 ARE NOT USED.
15. ON UNITS WITH SERIAL NO. PREFIX F: R20, R21 ARE 100 OHM 1/2W COMP.; ON UNITS WITH SERIAL NO. PREFIXES A-E: R17, R18 ARE 100 OHM 1/2W COMP.; Q1 THRU Q4 ARE FBN-L195; ON UNITS WITH SERIAL NO. PREFIX G: C31 THRU C34, CR101, CR102, CR201, CR202 ALL ARE NOT USED; R121, R122, R221, R222 ARE NO.22 AWG JUMPERS.
16. ON UNITS WITH "V" OPTION AND SERIAL NO. PREFIXES A-F: C29 NOT USED; ON STD. UNITS AND WITH "V" OPTION AND SERIAL NO. PREFIX G: R110 IS 22,000 OHMS ON 5V AND 6V UNITS.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES B-G

SCHEMATIC DIAGRAM REGULATED POWER SUPPLY

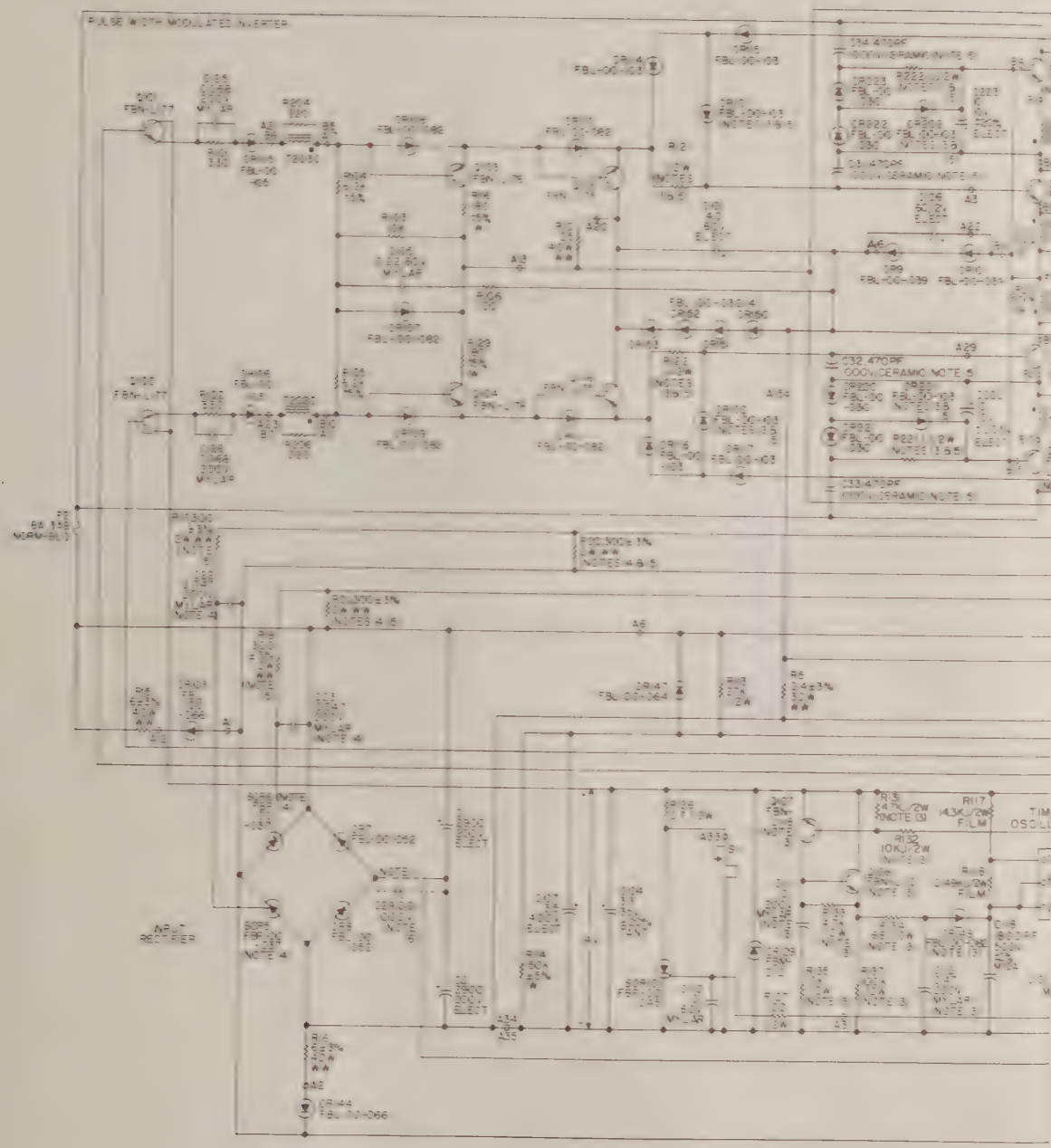
MODELS
LGS-EE-5-0V-R
LGS-EE-6-0V-R
LGS-EE-12-0V-R
LGS-EE-15-0V-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-20-OV-R THRU LGS-EE-28-OV-R
BEARING SERIAL NO. PREFIXES B-G

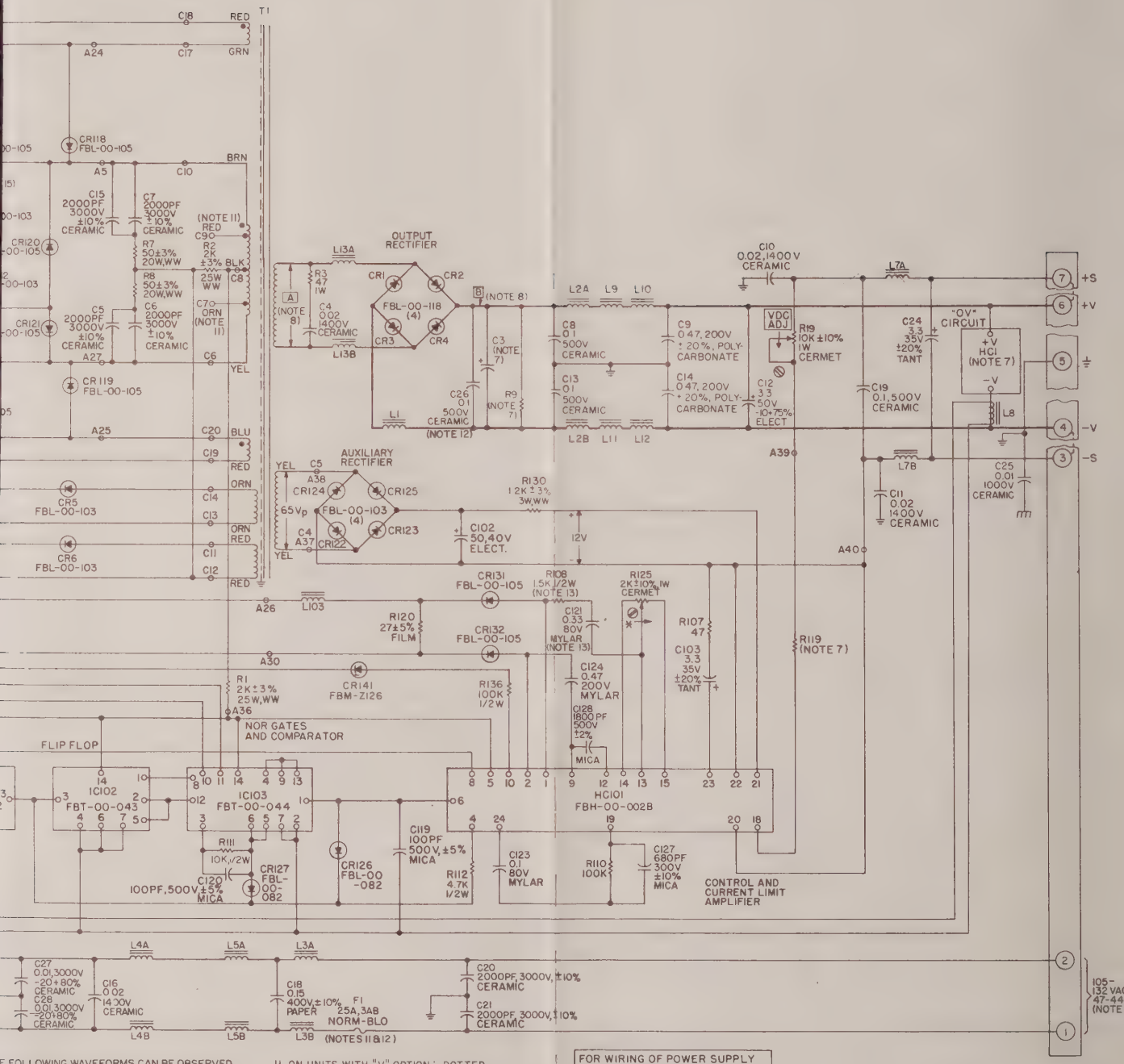
Models	Schematic Voltage Measurements		Schematic Components			
			C3	HC1	R9	R119
	A (Vp)	B (VDC)	-10+50% ELECT	L-20-0V-*	10W WW	±1%, 1/4W FILM
LGS-EE-20-OV-R	36	20.0	45,000 mf 25 vdc	20	150 ±5%	13.3K
LGS-EE-24-OV-R	43	24.0	32,000 mf 30 vdc	24	150 ±5%	18.2K
LGS-EE-28-OV-R	51	28.0	32,000 mf 30 vdc	28	220 ±3%	20K

*Lambda part no.

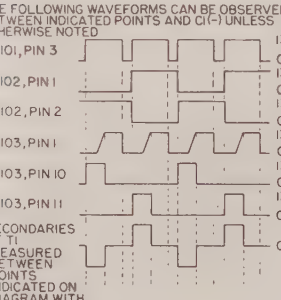


NOTES

1. RESISTORS ARE 1/4W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%, FILM ±1%, WIREWOUND ±5%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC −10 +100%, CERAMIC ±20%, MYLAR ±10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS
   - ▭ INDICATES ACTUAL UNIT MARKING
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ✱ SEE INSTRUCTION MANUAL
   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS INPUT: 115 VAC, 57-63 Hz, NOMINAL, VOLTAGE NO LOAD, +S AND +V SHORTED, −S AND −V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. AC MEASUREMENTS ARE PEAK VALU... MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND −S (TERM... UNLESS OTHERWISE NOTED.



E FOLLOWING WAVEFORMS CAN BE OBSERVED
TWEEN INDICATED POINTS AND CI(-) UNLESS
HERWISE NOTED



11. ON UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN TO CR7, CR8 REPLACES CONNECTION TO C1, C2; F1 IS 10A, T1 HAS TAPPED PRIMARY "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TERMINALS C7 AND C9) OR FOR 205-265V INPUT (USING TERMINALS C6 AND C10).
12. ON UNITS WITH SERIAL NO. PREFIXES B & C F1 IS 20A, C26 ONLY USED ON UNITS WITH SERIAL NO. PREFIXES B & C.
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FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES B-G

16. ON UNITS WITH "V" OPTION AND SERIAL NO. PREFIXES A-F: C29 NOT USED.

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

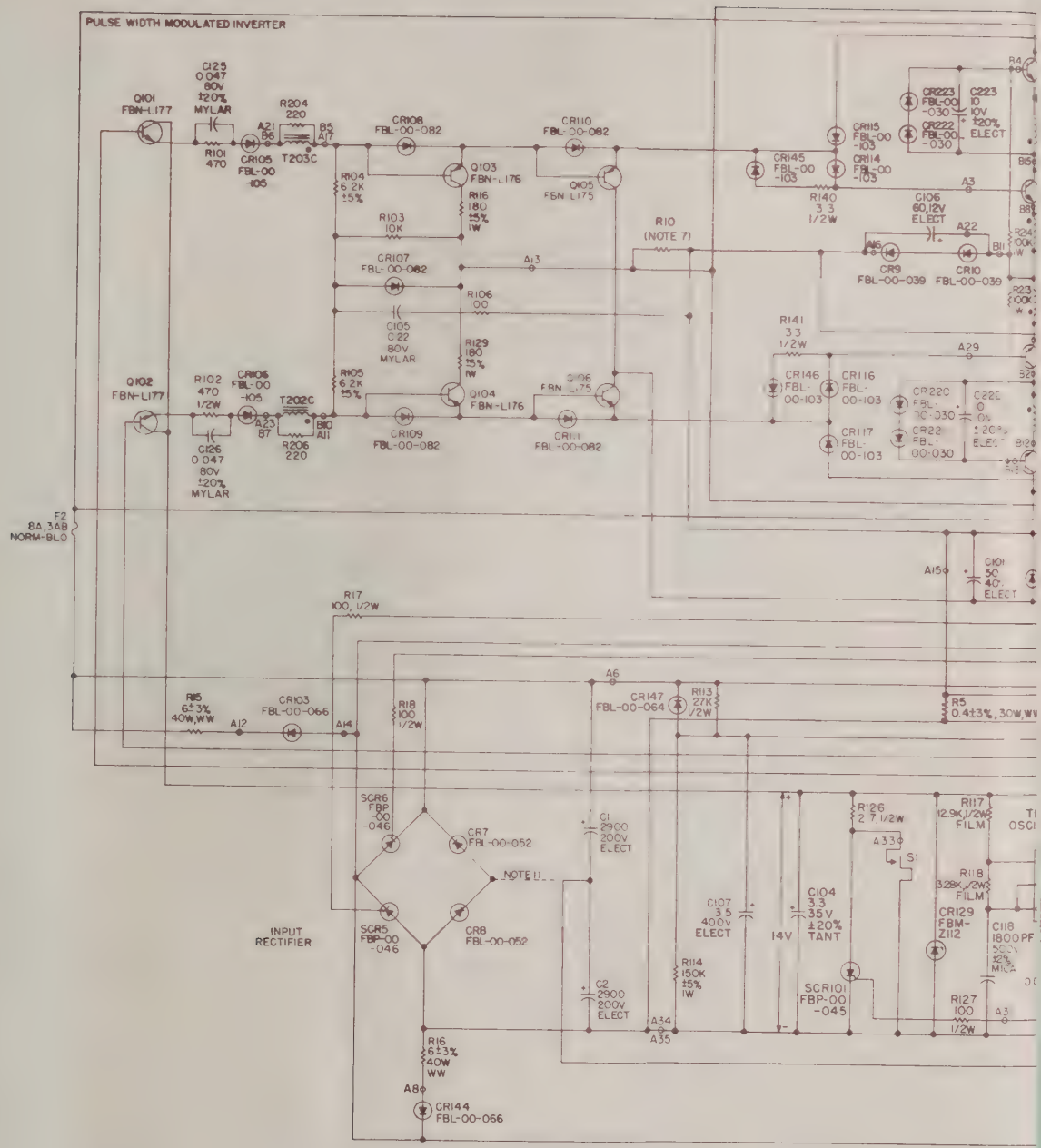
MODELS
LGS-EE-20-OV-R
LGS-EE 24-OV-R
LGS-EE 28-OV-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-5-0V-R THRU LGS-EE-15-0V-R
BEARING SERIAL NO. PREFIX A

Models	Schematic Voltage Measurements		Schematic Components						
			C3	CR1-CR4	HC1	R3	R9	R10	R119
	A (Vp)	B (VDC)	-10±50% ELECT	FBL-00-*	L-20-0V-*	±10%, 1w COMP	±3% WW	±5%, 40w WW	±1%, 1/4w FILM
LGS-EE-5-0V-R	11	5.0	100,000 mf 7.5 vdc	119	5	12	25 3W	16	Jumper
LGS-EE-6-0V-R	13	6.0	100,000 mf 7.5 vdc	119	6	12	25 3W	16	Jumper
LGS-EE-12-0V-R	22	12.0	65,000 mf 15 vdc	118	12	33	100 5W	25	7.5K
LGS-EE-15-0V-R	31	15.0	55,000 mf 17.5 vdc	118	15	33	100 5W	25	10K

* Lambda part no.



NOTES

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   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
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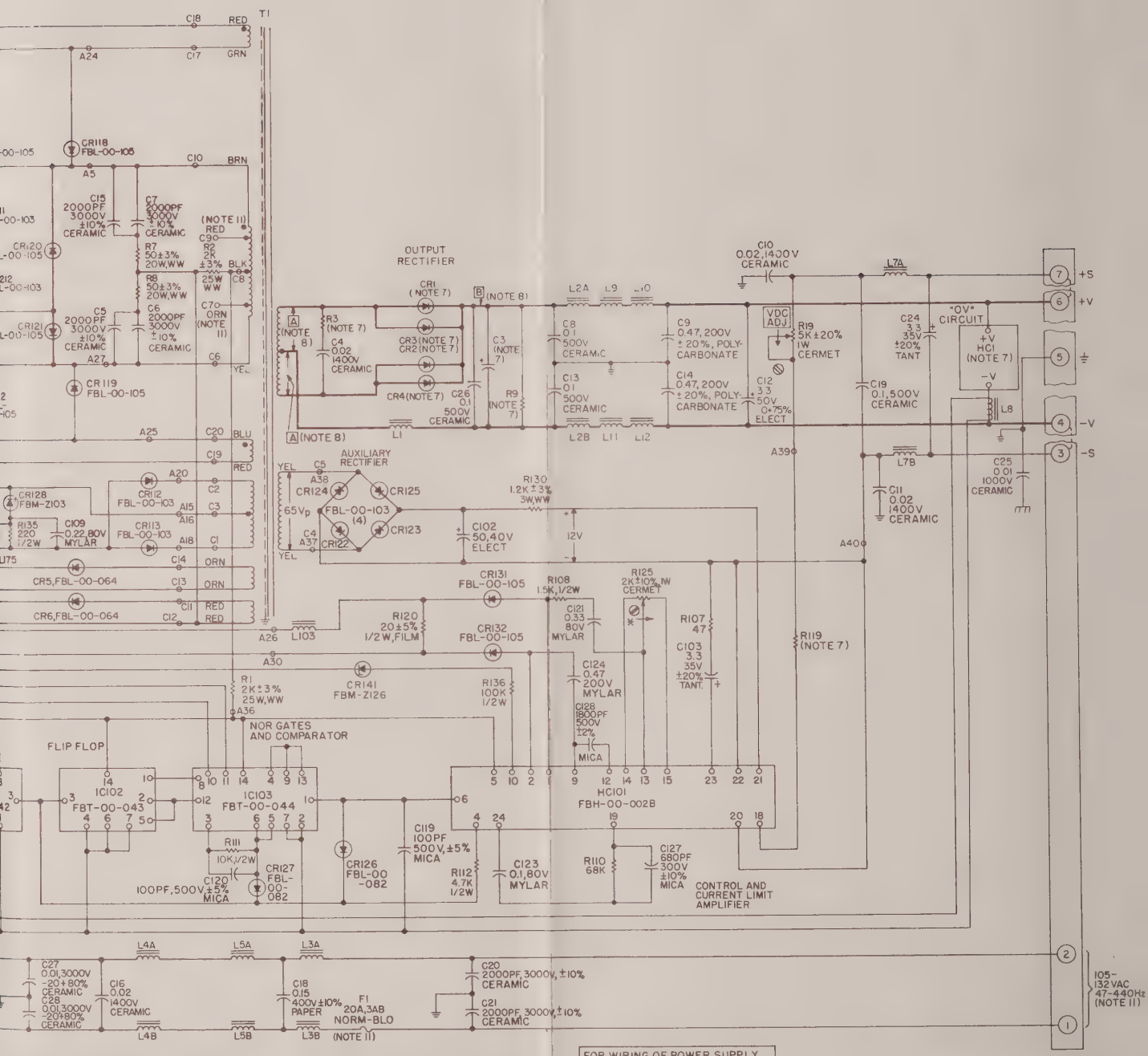
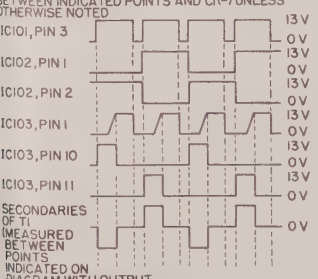
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENT INPUT: 115 VAC, 57-63 Hz. NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, −S AND −V SHORTED. INDICATED VOLTAGES ARE TYPICA VALUES AND ARE DC UNLESS OTHERWISE NOTE DC MEASUREMENTS TAKEN WITH 20,000 OHMS VOLTMETER. AC MEASUREMENTS ARE PEAK VAL MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND −S (TER UNLESS OTHERWISE NOTED.



THE FOLLOWING WAVEFORMS CAN BE OBSERVED BETWEEN INDICATED POINTS AND C1(-) UNLESS OTHERWISE NOTED


IC101, PIN 3
IC102, PIN 1
IC102, PIN 2
IC103, PIN 1
IC103, PIN 10
IC103, PIN 11
SECONDARIES OF T1 (MEASURED BETWEEN POINTS INDICATED ON DIAGRAM WITH OUTPUT LOADED TO 10% OF RATED CURRENT MINIMUM)
13 V
0 V

11. ON UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN TO CR7, CR8 REPLACES CONNECTION TO C1, C2; F1 IS 10A; T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TERMINALS C7 AND C9) OR FOR 205-265V INPUT (USING TERMINALS C6 AND C10).

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

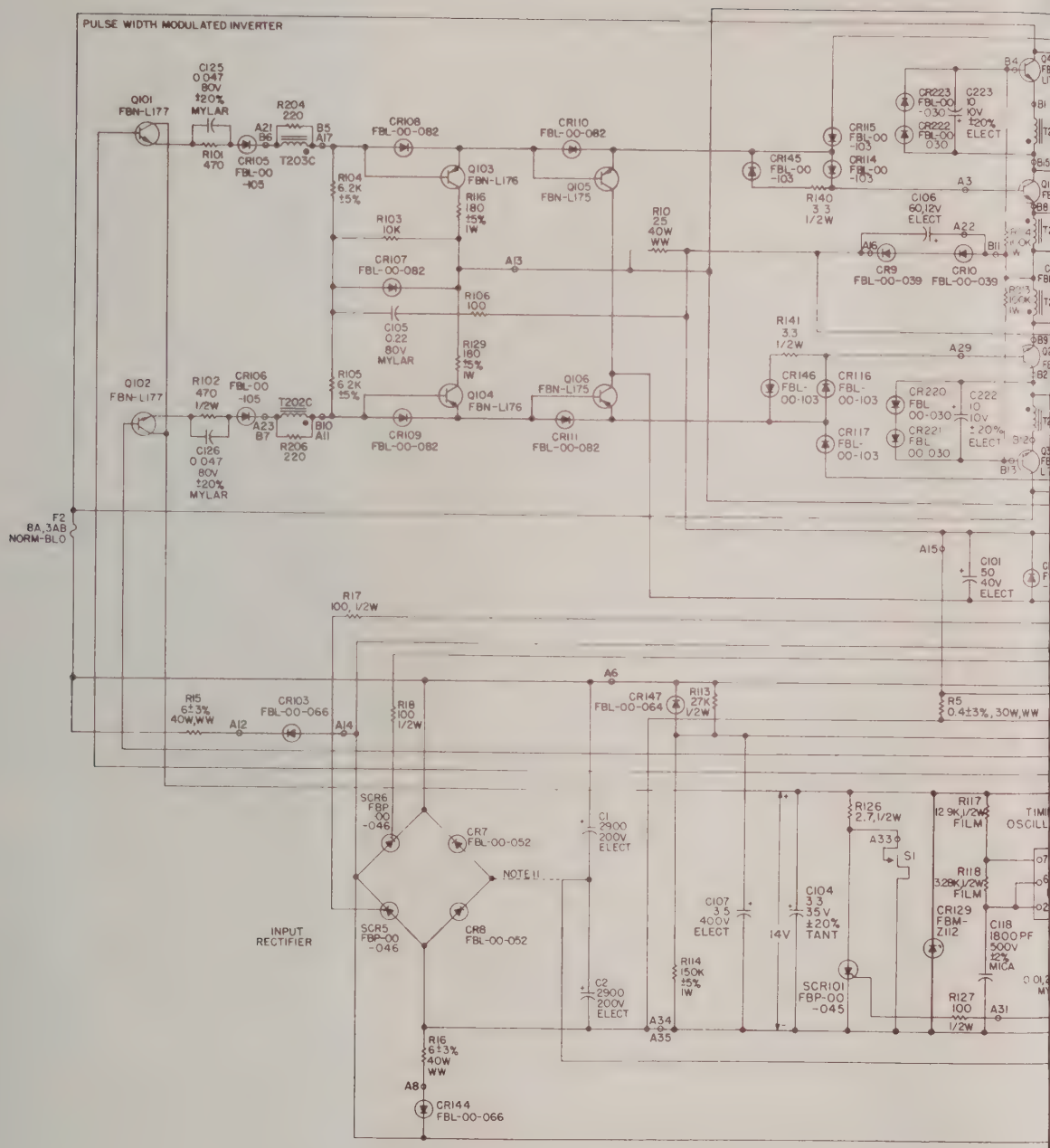
MODELS
LGS-EE-5-OV-R
LGS-EE-6-OV-R
LGS-EE-12-OV-R
LGS-EE-15-OV-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-20-OV-R THRU LGS-EE-28-OV-R
BEARING SERIAL NO. PREFIX A

Models	Schematic Voltage Measurements		Schematic Components			
			C3	HC1	R9	R119
	A (Vp)	B (VDC)	-10+50% ELECT	L-20-0V-*	10W WW	±1%, 1/4W FILM
LGS-EE-20-OV-R	36	20.0	45,000 mf 25 vdc	20	150 ±5%	13.3K
LGS-EE-24-OV-R	43	24.0	32,000 mf 30 vdc	24	150 ±5%	18.2K
LGS-EE-28-OV-R	51	28.0	32,000 mf 30 vdc	28	220 ±3%	20K

*Lambda part no.



NOTES

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   - ▭ INDICATES ACTUAL UNIT MARKING
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   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
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6. DESIGNATIONS ARE LAMBDA PART NUMBERS
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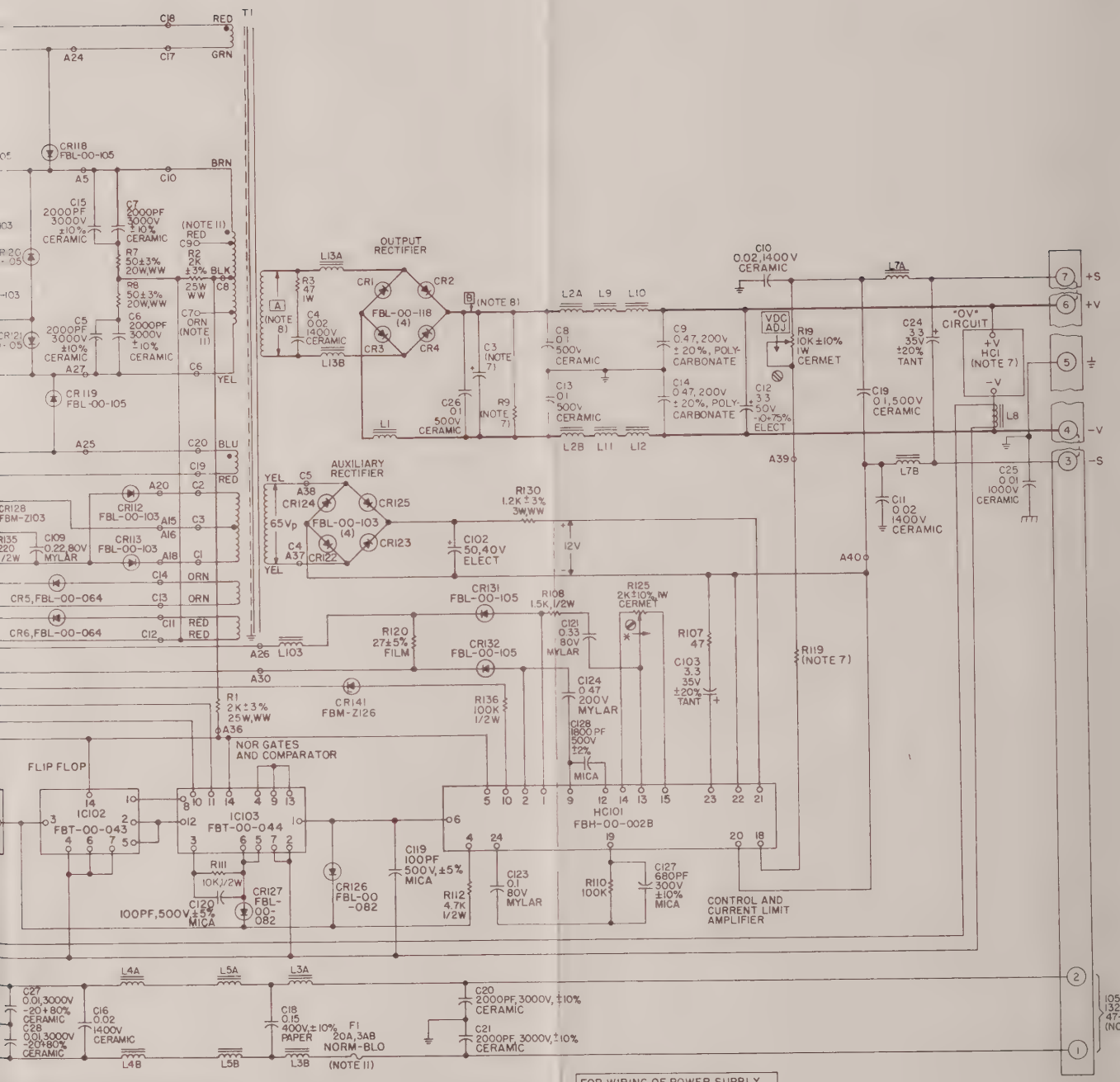
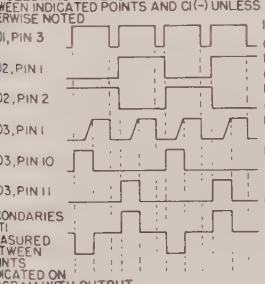
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 57-63 Hz. NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. AC MEASUREMENTS ARE PEAK VALUE MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S (TERM. UNLESS OTHERWISE NOTED.



FOLLOWING WAVEFORMS CAN BE OBSERVED WEEN INDICATED POINTS AND CI(-) UNLESS RWISE NOTED



11. ON UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN TO CR7, CR8 REPLACES CONNECTION TO C1, C2; F1 IS 10A; T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TERMINALS C7 AND C9) OR FOR 205-265V INPUT (USING TERMINALS C6 AND C10).

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

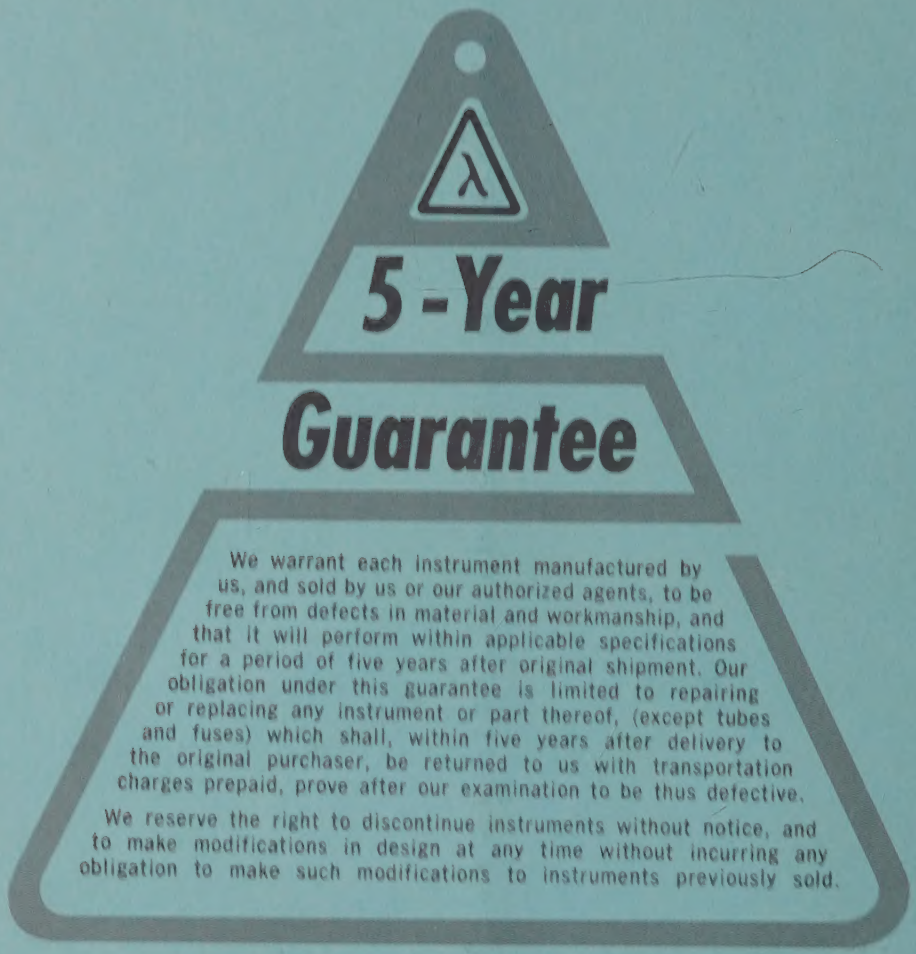
DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LGS-EE-20-OV-R
LGS-EE-24-OV-R
LGS-EE-28-OV-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.


5-Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS
515 BROAD HOLLOW ROAD • MELVILLE, L. I., NEW YORK • 516 MYRTLE 4-4200

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